PALEONTOLOGY.—*Paleocene mammals from the Denver Basin, Colorado.*[1] C. LEWIS GAZIN, U. S. National Museum.

The untiring search by Dr. Roland W. Brown, of the U. S. Geological Survey, for Paleocene mammal remains in the Denver Basin resulted during the field seasons of 1939 and 1940 in the discovery of certain materials indicative of Paleocene age. The specimens are of a rather fragmentary nature, but their occurrence at strategic localities warrants a somewhat more detailed description than might otherwise have been given. The localities involved are of historic importance in the Cretaceous–Tertiary boundary controversy, and the mammals herein described, together with the previously known occurrences of dinosaur materials, serve to determine this boundary or greatly to restrict the known limits of its possible position in this region.

The two principal localities are the small but conspicuous area of exposure on the southeastern portion of South Table Mountain (Fig. 1), near Golden, Colo., and in an amphitheater of badlands called Corral Bluffs, east of Jimmy Camp Creek, about 14 miles east of Colorado Springs. The writer visited the region of the second locality in 1932 in the company of L. W. Nicklaus, of Colorado Springs, and the South Table Mountain with R. W. Brown in 1940.

The South Table Mountain materials are, as determined by Brown, from SW $\frac{1}{4}$ NW $\frac{1}{4}$, sec. 31, T. 3 S., R. 69 W., in the lower part of the Denver formation, about 50 feet above the highest occurrences of dinosaur materials in the same formation. The section at this locality may be seen from a distance to include a lower dark zone, a middle light-colored band, and an upper dark band, including the basaltic lava cap of the mesa. Brown has found that the lower part of the exposed section, entirely within the Denver formation, includes about 21 feet of drab-green andesitic sandstone with dinosaur and turtle remains, capped by a 3-foot bed of drab conglomerate. Fifty feet above this and about 225 feet below the basalt the mammalian remains occurred, together with specimens of the typical Denver flora, in a light, sandy clay bed of the middle light-colored zone. Hence the Cretaceous–Tertiary transition is seen to occur within the lower part of the Denver formation, between the dark dinosaur-bearing deposits and the mammal and plant horizon in the light, sandy clay zone. The boundary is considered by Brown to be at about the base of the light-colored middle zone (see Fig. 1).

[1] Published by permission of the Secretary, Smithsonian Institution. Received May 21, 1941.

Fig. 1.—Exposures on southeast face of South Table Mountain, near Golden, Colo. The man stands at the place where the jaw of *Baioconodon denverensis* was found. The arrows indicate the position of the Cretaceous–Tertiary boundary as interpreted by R. W. Brown. Photograph by Brown.

The mammalian materials from South Table Mountain include a lower jaw fragment with two teeth, herein described as representing a new genus and species, *Baioconodon denverensis*. The form appears most closely related to lower Paleocene creodonts and seems beyond reasonable doubt to be Paleocene in age. Two other lower jaw portions, with teeth not preserved or too worn for certain recognition, are tentatively referred to this form. A fourth small jaw fragment with most of two premolars preserved, but well worn, may represent an anisonchine periptychid.

The South Table Mountain Paleocene fauna as known may be listed as follows:

Reptilia:
- *Allognathosuchus* sp.
- *Compsemys* sp.
- Trionychid sp.

Mammalia:
- *Baioconodon denverensis*, n. gen. and sp.
- Periptychid? sp.

The crocodile teeth and fragments of turtle shell were identified by

C. W. Gilmore, of the National Museum. These are of a highly fragmentary nature and apparently of little or no stratigraphic significance.

The Tertiary in the region east of Colorado Springs, in the vicinity of Corral Bluffs and Jimmy Camp Creek, has produced, in addition to undetermined turtle fragments, three mammal specimens. A specimen collected by R. W. Brown and C. E. Staudte at Corral Bluffs to the east of Jimmy Camp Creek is the most readily identified and includes upper and lower jaw material with teeth. It is referred to the Puercan species *Conacodon entoconus* (Cope).[2] The specimen was found in the northeast "corner" of the "amphitheater" on the saddle of a long spur projecting southward toward State Highway 94, in $SW\frac{1}{4}NE\frac{1}{4}$ sec. 6, T. 14 S., R. 64 W. The lower Paleocene age of the specimen is evident, and this horizon, identified by Brown as high in the lower part of the Dawson Arkose, is closely related in time to the Puerco of New Mexico. The mammal level was determined by Brown to be approximately 100 feet above the dinosaur bearing beds farther west on Jimmy Camp Creek.

A specimen found by Richardson,[3] and identified by Gidley as a creodont tibia of Eocene age, came from farther west near Jimmy Camp Creek, $SW\frac{1}{4}$ sec. 2, T. 14 S., R. 65 W., 600 feet above the base of the Dawson Arkose. Brown has checked this locality and finds that no dinosaur-bearing strata outcrop in this section and that the tibia comes from about 100 feet above the dinosaur material reported by W. T. Lee,[4] roughly equivalent to the level of the *Conacodon* jaws in Corral Bluffs. The creodont tibia is not in the collections of the National Museum; however, the fact of its being a tibia suggests that no accurate diagnosis was feasible, other than an early Tertiary age. Hence, a Paleocene age seems entirely possible. Gidley's statement, of course, did not preclude the possibility of such an age assignment because at the time of Richardson's folio, 1912, the U. S. Geological Survey did not recognize the term Paleocene.

From the evidence of this mammalian material, particularly the *Conacodon* jaws, together with the known occurrences of dinosaur remains, it is concluded that the Cretaceous–Tertiary boundary here comes high in the lower part of the Dawson Arkose, at an horizon that, according to Brown, is near the base of the zone of workable coals, between 500 and 600 feet above the base of the formation.

[2] See W. D. MATTHEW. Trans. Amer. Philos. Soc., n.s., **30**: 145–149, fig. 30. 1937.
[3] G. B. RICHARDSON. Bull. Geol. Soc. Amer. **23**: 272. 1912. Also, U. S. Geol. Surv. Folio **198**: 8. 1915.
[4] W. T. LEE. Amer. Journ. Sci. (4) **35**: 531. 1913.

The specimen found by L. W. Nicklaus in the Corral Bluffs apparently comes from a somewhat lower level than the *Conacodon* jaws and constitutes further evidence for the presence of a large creodont in the Dawson Arkose.

The materials from the Dawson formation east of Colorado Springs may be listed as follows:

Reptilia:
- *Champsosaurus?*[5] sp.
- Testudinate remains

Mammalia:
- Creodont, near *Eoconodon heilprinianus* (Cope)
- Creodont, undet.
- *Carsioptychus?*[5] sp.
- *Conacodon* cf. *entoconus* (Cope)

In addition to the above occurrences mention may be made, as a matter of record, of a small mammal jaw without teeth, which, together with turtle remains, was found by Brown in 1940 near a coal mine in sec. 2, T. 9 S., R. 62 W., about 3.3 miles west of Norton, Colo., and east of Castle Rock. The specimen may be from a Paleocene mammal, though certainly not determinable, and comes from the upper part of the lower Dawson. The form is near the size of *Ellipsodon lemuroides*, and as in most species of that genus, it had its third molar reduced in size, as indicated by the root portions of the teeth.

CREODONTA

Baioconodon,[6] n. gen.

Generic characters.—Trigonid of lower molars moderately elevated, with paraconid lingual and well defined. Ridge extending anterolingually from hypoconid joins posterior wall of trigonid at distinctly lingual point. M_3 unreduced, with hypoconulid crenulate and talonid basin exhibiting rugae. External cingulae developed.

Genotype.—*Baioconodon denverensis*, n. sp.

Baioconodon denverensis, n. sp.

Type.—Portion of right ramus of mandible with M_2 and M_3, U. S. N. M. no. 16621.

Horizon and locality.—Denver formation, lower Paleocene, South Table Mountain, near Golden, Colo., in $SW\frac{1}{4}$ $NW\frac{1}{4}$ sec. 31, T. 3 S., R. 69 W.

Specific characters.—Size much smaller than *Eoconodon heilprinianus*, near that of *Loxolophus priscus*. Specific characters not otherwise distinguished from generic characters.

Description.—The jaw fragment of *Baioconodon* is not greatly different in

[5] Additional materials collected by R. W. Brown and the writer on June 5, 1941, from the Dawson Arkose at Corral Bluffs include specimens tentatively identified, while in the field, as *Champsosaurus* and *Carsioptychus*. The reptilian form is represented by several vertebrae and the periptychid mammal by fragments of a right lower jaw with only the root portions of the teeth from P_4 to M_3 and a separate right lower jaw fragment with one of the premolars preserved. *Champsosaurus* is known from several Paleocene occurrences and *Carsioptychus* is characteristic of the Puercan stage of the Paleocene.

[6] βαιός, small, + *conodon*, as in *Eoconodon*.

size from that of *Loxolophus priscus*, much smaller than in *Eoconodon heilprinianus*, which it more closely resembles in the structure of the molars. The talonid portion of M_2 is about the same width as the trigonid, and having about the same anteroposterior extent. M_3 shows almost no reduction in size from that of M_2, and the talonid portion is a little longer and narrower than the trigonid. The trigonid portions of both teeth are elevated with respect to the talonids, but apparently a little less so than observed in some material of *Eoconodon*. The paraconid of both molars is well defined, lingual in position, and rather sharply distinct from the metaconid. The talonid portion is well basined and exhibits a distinct hypoconid, entoconid, and hypoconulid, the well-developed posterior crest or hypoconulid on M_3 being

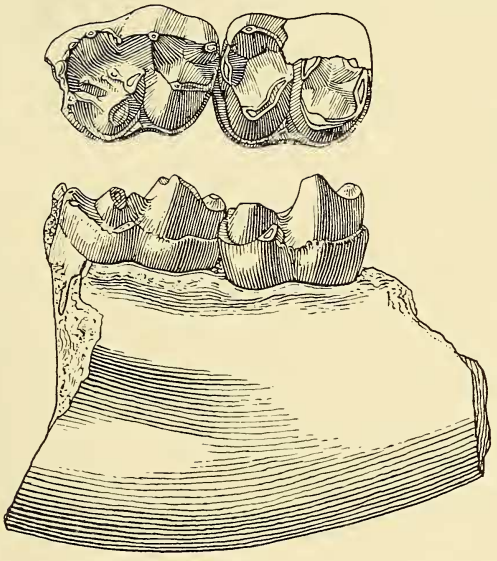

Fig. 2.—*Baioconodon denverensis*, n. gen. and sp. Portion of right ramus of mandible with M_2 and M_3, U.S.N.M. no. 16621, type specimen, lateral and occlusal views. ×3. Denver Paleocene, Golden, Colo. Drawing by Sydney Prentice.

somewhat crenulated. The basin of M_3 is further characterized by sharp crests, one long and one short, extending into the basin posterolingually from the ridge anterolingual to the hypoconid. The principal character of the talonid portion of the molar is the markedly lingual point at which the crest extending anterolingually from the hypoconid joins the trigonid portion of the tooth, this being a noticeable distinction when comparison is made with material of *Loxolophus*, and is most closely approached in the large *Eoconodon*. The two lower molars of *Baioconodon denverensis* are also characterized by a prominent external cingulum which shows a conspicuous cusp between the protoconid and hypoconid, especially in M_2 where it extends inward noticeably between the principal outer cusps.

The anteroposterior diameters of M_2 and M_3 are 6.8 and approximately 8.5 mm., and their greatest transverse diameters about 6 and 5.6 mm, respectively.

In comparison with material of *Loxolophus*, M_3 in *Baioconodon denverensis* is seen to be less reduced in size. The paraconid occupies a more lingual position in both M_2 and M_3 and the talonid portion in M_2 appears relatively shorter anteroposteriorly. The crest extending forward from the hypoconid

joins the trigonid at a much more lingual position, and the external cingulum is better developed than in any of the *Loxolophus* material examined.

Baioconodon denverensis is considerably smaller than *Eoconodon heilprinianus*, and the paraconid on the last two molars is relatively better developed, higher, and more distinct from the metaconid. The trigonid, though elevated with respect to the talonid, is relatively not so high as in teeth of *Eoconodon* showing comparable wear. M_3 in *Baioconodon denverensis* is a little larger with respect to M_2, and also shows a somewhat more complex talonid portion than in *Eoconodon heilprinianus*. M_3 seems slightly more reduced in *Eoconodon gaudrianus* (Amer. Mus. no. 3400) but much more reduced in *Goniacodon*.

Two other specimens from the same locality on South Table Mountain, exhibiting greater portions of the mandible, but with the teeth broken off or too badly worn for certain recognition, may also represent *Baioconodon denverensis*, although there is no certainty that they do. No. 16622, a right mandibular portion possessing only the root portions of P_4 to M_3, is of a little greater size than the type, and the masseteric crest does not extend so far forward, although the roots of the teeth have the same shape and proportions as in no. 16621. If the two are conspecific, the edentulous jaw may well be from a much older individual, as the teeth in the type are but very little worn.

No. 16624 is a left mandibular ramus, exhibiting root portions of the teeth from the canine to M_3. The molars have their crowns partially preserved but so badly worn as to be unrecognizable. Much of the wear on these and the root portions of the preceding teeth may have been largely erosion post mortem. The jaw itself is a little more slender below the molars than either no. 16621 or 16622, but the depth is intermediate between the two. The teeth, however, appear to have been slightly smaller than in either and the root portions of M_1 relatively a little narrower, perhaps more indicative of *Loxolophus*, which it may well represent, although the root portions of the premolars suggest that these teeth may have been relatively wider and more closely spaced than in material of *Loxolophus* at hand.

Creodont, near **Eoconodon heilprinianus** (Cope)

A fragment of a left ramus of the mandible with an almost unworn lower molar, U. S. N. M. no. 16626, was found by L. W. Nicklaus, of Colorado Springs, in the bluffs near Jimmy Camp Creek east of Colorado Springs. The form represented, clearly a large creodont, is apparently of the triisodontine or possibly arctocyonine type. The molar is of about the size of M_1 in *Eoconodon heilprinianus* but is a little shorter and wider. It rather noticeably resembles lower teeth of this form in the characters of the cusps. The outline of the tooth suggests that it may be a first lower molar, but the cusps or pattern of the trigonid more closely resembles M_2 in *E. heilprinianus*. The trigonid is less elevated, but the paraconid is decidedly forward and lingual in position as in that form. The talonid portion is relatively shorter and wider than in *Eoconodon* and the basin is correspondingly wider, but the crest extending anterolingually from the hypocone joins the posterior wall of the trigonid at a position almost as lingual as in *Eoconodon*, much more so than in *Claenodon*.

The specimen seems to represent neither *Protogonodon* nor *Claenodon*, as indicated by characters of both the trigonid and talonid of the tooth, but may be from a form of *Eoconodon;* however, because of the somewhat more brachydont trigonid portion, it is not regarded at present as certainly representing a species of that genus.

CONDYLARTHRA

Conacodon cf. **entoconus** (Cope)

Portions of both maxillae with several well-worn cheek teeth and a left ramus of the mandible with P_2, P_3, and the three molars, all belonging to the same individual, U. S. N. M. no. 16625, were found by Brown and Staudte east of Jimmy Camp Creek, about 14 miles east of Colorado Springs and in the Dawson formation ($SW\frac{1}{4}NE\frac{1}{4}$ sec. 6, T. 14 S., R. 64 W.). The form is a periptychid condylarth and apparently represents the species *Conacodon entoconus*. The teeth are rather well worn but not so much so as to leave any doubt as to the affinities of the form. The development of the premolars as indicated in the right maxilla and lower jaw is in a stage equivalent to that seen in Puerco material, and the teeth in general are entirely comparable, except for a little greater width of the lower molars than in any of the Puerco material at hand. The upper molars may also have been relatively wide, but all these are damaged along the outer wall, and this, together with the sloping character of inner wall, prevents accurate measurement.

Periptychid? sp.

A small fragment of a lower jaw, no. 16623, with one complete premolar, P_3 or P_4, and half of the preceding tooth, both well worn, was found by Brown at the South Table Mountain locality. The specimen appears to be of a periptychid type of mammal, and the development of the premolars is about intermediate between the Puercan forms *Hemithlaeus kowalevskianus* and *Conacodon entoconus*. Although well worn, the extent of the talonid portion on each tooth can be ascertained, and this seems more nearly equivalent to that in *Hemithlaeus*, not so reduced as in *Conacodon*, although the premolars as a whole approach in size those of *Conacodon entoconus*. The specimen was found in close association with no. 16622, referred tentatively to *Baioconodon denverensis*, but because of duplication of parts, it can not belong to the same individual. These may well be premolars of *B. denverensis*, as indicated by the size of the roots, but the crown portions are suggestive of an anisonchine periptychid rather than a creodont.